OAK RIDGE NATIONAL LABORATORY
operated by
UNION CARBIDE CORPORATION
NUCLEAR DIVISION
for the
U.S. ATOMIC ENERGY COMMISSION

UNION CARBIDE

ORNL-TM-2190

BIOLOGY DIVISION

NEUROSPORA EXPERIMENT P-1037

QUARTERLY PROGRESS REPORT

TO THE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MARCH 16 - JUNE 30, 1967

NOTICE This document contains information of a preliminary nature and was prepared primarily for internal use at the Oak Ridge National Laboratory. It is subject to revision or correction and therefore does not represent a final report.

ORNL-TM-2189

BIOLOGY DIVISION

NEUROSPORA EXPERIMENT P-1037

QUARTERLY PROGRESS REPORT

TO THE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

DECEMBER 16, 1966 - MARCH 15, 1967

MAY 1968

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee
operated by
UNION CARBIDE CORPORATION
for the
U. S. ATOMIC ENERGY COMMISSION

QUARTERLY PROGRESS REPORT
TO THE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Title of Project: Mutagenic Effectiveness of Known Doses of Gamma Irradiation in Combination with Zero Gravity on Neurospora.

For the Period: December 16, 1966 - March 15, 1967

Principal Investigator:

Frederick J. de Serres

Coinvestigator:

Brooke B. Webber

Technical Staff:

Earle C. Gourley
David S. Carroll
Ida C. Miller
John S. Wassom
Della W. Ramey
Letha Oggs
Linda B. Ralston
Marilyn T. Sheppard
Paula E. Harris
William P. Henry
Arlee P. Teasley
Mary C. Gibson

Consultant:

Diana B. Smith
Biometrics and Statistics
Oak Ridge National Laboratory
Oak Ridge, Tennessee

Name of Institution:

Biology Division
Oak Ridge National Laboratory

Address:

P. O. Box Y
Oak Ridge, Tennessee 37830

Interagency Agreement:

Purchase Order R-104, Task No. 8

Experiment Proposal No.:

P-1037

Supported by:

Research jointly sponsored by the National Aeronautics and Space Administration, and by the U. S. Atomic Energy Commission under contract with the Union Carbide Corporation.

PRECEDING PAGE BLANK NOT FILMED.

CONTENTS

I. Introduction . . . .

II. Personnel Deployment . . . .

III. Biosatellite A Flight and Preparations . . . .

IV. Dosimetry for Biosatellite A Flight . . . .

V. Heterokaryotic Survival in Conidial Platings from Biosatellite A Ground Control Experiment . . . .

VI. Jug Data for Biosatellite A Ground Control Experiment . . . .

VII. Selection of Mutants for Further Genetic Analysis . . . .

VIII. Conclusions Concerning the Biosatellite A Exercise . . . .

IX. Data Recording and Electronic Data Processing . . . .

I. INTRODUCTION

The present report for the period of 16 December 1966 through 15 March 1967 covers the activities associated with the flight of Biosatellite A and the post-flight assays to determine the genetic effects of ^{85}Sr gamma radiation in the ground control portion of the experiment. A previous document (ORNL-TM-1734) has described the design of the experiment, the development, qualification, and final form of the experimental hardware, early dosimetric procedures, storage and anoxia experiments, and biocompatibility testing. A more recent document (ORNL-TM-1959) has discussed the assignment and field training of personnel for the Cape Kennedy and Hickam Field operations and the results of additional biocompatibility tests with flight hardware. This later report also covers the 301 and 302 gantry exercises held immediately prior to the Biosatellite A flight.

II. PERSONNEL DEPLOYMENT

A previous document (ORNL-TM-1959) contains an outline of the original field test and flight deployment plans for the Neurospora experiment and a discussion of the alterations which were made in these plans. The outline of the experiment plan included arrangements for: (1) a team to prepare the modules containing both biological material and dosimeters at ORNL; (2) three transport teams (with alternates) to transport experiment modules between ORNL and Cape Kennedy and to provide fresh samples at two-day intervals during a readiness flight period of indefinite duration; (3) a two-man team at Cape Kennedy to assemble the Neurospora packages and to provide continuous monitoring of the Neurospora laboratory during the flight readiness and flight periods; and (4) a technician to be responsible for the processing of Neurospora assemblies at Hickam Field after recovery and to transport them back to ORNL for genetic analysis.

Besides dealing with the responsibilities related strictly to the Neurospora experiment, the principal investigator and the coinvestigator were assigned more general roles in the project. Dr. de Serres, who had been elected by the experimenters as their representative, was assigned the responsibility of monitoring the insertion of the experimental packages into the fore and aft payloads in the Hanger S clean room and the insertion of the payloads into the space craft on the gantry at the launch pad just prior to launch. In this way the interests of the individual experimenters were to be served by a person sensitive to the biological requirements at the time when the experimenters no longer had personal access to their experimental materials. Dr. de Serres was also assigned the responsibility of monitoring the disassembly of the recovery capsule at Hickam Field after recovery (nominally, after 66 hours of flight). Dr. Webber was assigned the responsibility of serving with personnel from General Electric and NASA in a Samoan contingency detail. In the event of an early call-down in the Samoa area this team had the responsibility for space craft dissassembly in Samoa and processing of all biological material in the event that this could not be done at Hickam Field. During the flight period, Dr. Webber cooperated with other experimenters and Ames Research Center personnel in maintaining telephone contact by the direct lines to Goddard Space Center and Cape Kennedy and in recording telemetered data which were first collected at Goddard Space Center from the tracking stations and then transmitted by phone to Hickam Field.

The deployment of personnel associated with the Neurospora experiment was summarized previously in ORNL-TM-1959. In Table 2 of that report personnel and their responsibilities during the flight readiness period are indicated.

III. BIOSATELLITE A FLIGHT AND PREPARATIONS

On 12 December 1966 conidia (asexual spores) from 24 flask cultures of heterokaryon 12 were harvested with glass beads and water to break up the chains of conidia, washed several times with sterile water, and made into a suspension in water with an estimated concentration of 5.1×10^6 conidia/ml. After dilution and plating, the colony counts indicated that the heterokaryotic viability was 18.7% of the total conidial count and general survival (i.e., survival of all conidia capable of growing on a fully supplemented medium) was 62.0%. Ten-ml samples of suspension were deposited onto each of 150 Millipore filters and these were inserted in groups of ten into each of 15 sterile modules. The module numbers used are indicated in Table 1, a copy of the DD1149 Requisition and Invoice/Shipping Document, which accompanied the modules during their delivery by ORNL personnel at ice-water temperature to Cape Kennedy on 13 December 1966. The list includes six modules, of which five were inserted into the capsule and one was used as a back-up, and nine additional modules to be used for the ground control portion of the experiment.

On 14 December 1966 the six flight modules were removed from the refrigerator at Cape Kennedy and inserted into sterile housings by 0138 hrs E. S. T. (0638 hrs G. M. T.). Insertion of the control I and control II modules into housings was completed by 0154 hrs E. S. T. and insertion of the control III (lapsed time control) modules into housings was completed by 0537 hrs E. S. T. Launch was nominal, occurring at 1420 hrs E. S. T. (1920 hrs G. M. T.), and the mission remained essentially nominal until time for reentry of the recovery capsule.

The modules and housing numbers for flight and each type of control are listed in Table 2, along with a brief summary statement about the temperature readings for each Neurospora assembly. In tests made before the flight, the Neurospora thermistors had often failed to function properly and this anomaly was also observed in the Biosatellite A flight. Three of the five Neurospora flight assembly termistors gave apparently inaccurate temperature readings. The difficulty was attributed to the pre-test and pre-flight autoclaving of the housings and thermistors (which project through the housing walls and into the compartments in which the modules are each housed). Temperature readings for adjacent unautoclaved thermistors on other experiment packages supported the conclusion that the temperatures of the Neurospora housings could not have been as high as the telemetered read-outs indicated. The specifications for the Neurospora assemblies required that the assembly components be autoclavable, but at this time no explanation had been found for the erratic thermistor difficulty.

The capsule containing the biological material was not recovered after the nominal period of 47 orbits because, although the capsule separated from the adaptor on command, it did not de-orbit. It is also a matter of record that attempts to detect the capsule during its spontaneous re-entry some months later in the vicinity of Australia were unsuccessful. In a subsequent failure analysis, the early failure was attributed to malfunction of the retro-motor or of the electrical circuits designed to activate the retro-motor. It was also later discovered that the gravity switch which deploys the parachute and radio beacon may have been installed improperly, which could account for loss of the capsule near Australia and would have resulted in its loss even if the retro-motor had functioned properly.

Although the flight material was lost, the ground control material was subjected to genetic analysis, as described below.

IV. DOSIMETRY FOR BIOSATELLITE A GROUND CONTROL EXPERIMENT

A subsequent report will describe in more detail some of the difficulties encountered in development of a reliable passive dosimetry system for the Neurospora experiment. For the Biosatellite A ground control experiment, estimates of the gamma radiation exposures at the isodose lines corresponding to each of the biological sample positions were obtained from sets of three 5-mil thick lithium fluoride teflon disk dosimeters. These dosimeters were placed adjacent to the biological samples in filter disks 1, 2, 6, 9, and 10 in each module. The calibration curve (Figure 1) that was used for the Ames Biocompatibility tests (ORNL-TM-1734) and for the 301 and 302 gantry exercises (ORNL-TM-1959) was again used for the Biosatellite A experiment.

Dosimeters from a single large shipment with presumed uniform sensitivity had been given known exposures of ^{85}Sr gamma radiation and their average thermoluminescence readings were used to obtain the calibration curve. The calibration curve was used to convert thermoluminescence readings from the dosimeters in the ground control modules into Roentgen exposures. These exposures were then plotted against the distance of each dosimeter from the center of the gamma radiation source and a regression line was obtained for log of exposure vs. log of distance from the source. The readings from this line were used to estimate the exposure at each filter position. The estimated exposures and data used to obtain them are in Table 3, and the numbers of the filters which were used in the genetic analysis are marked there with asterisks. The selection of filters was such that samples were rather evenly distributed over the widest possible range of effective radiation exposures.

V. HETEROKARYOTIC SURVIVAL IN CONIDIAL PLATINGS FROM BIOSATELLITE A GROUND CONTROL EXPERIMENT

Treatment numbers were assigned to each of the samples selected for analysis, and each sample was placed into 10 ml of water in a test tube in an ice-water bath. The conidial samples on filters were inserted into tubes of water; the tubes were gyrated and the conidia were scraped from the filters with a spatula, after which the filters were removed. An aliquot of each suspension was then diluted by a factor of 10^4 and the dilution was used for platings to assay the survival of each homokaryotic fraction and of heterokaryotic conidia. Aliquots of the remainder of the suspensions were added to 12-liter Florence flasks to allow each heterokaryotic survivor to grow and form a 1 to 2 mm spherical colony which permits assay of survival and determination of the frequency of mutation in the ad-3 region. Haemocytometer counts were also made on six aliquots (2×10^{-5} ml/aliquot) of each original suspension to estimate the conidial concentrations (usually 5×10^6 conidia/ml). From the 10^{-4} dilution of each original suspension the following platings were made:

(A) Two ml in 100 ml of minimal medium.

(B) Replicate of (A).

(C) Two ml in 100 ml of medium supplemented with 2 mg/liter calcium pantothenate.

(D) One ml in 100 ml of HANI medium (supplemented with 100 mg/liter DL-histidine·HCl·H_2O, 100 mg/liter adenine sulfate, 10 mg/liter nicotinamide, and 8 mg/liter inositol).

(E) One ml in 100 ml of HANIP medium (supplemented with histidine, adenine, nicotinamide, and inositol as in D above plus 2 mg/liter of calcium pantothenate).

(F) Replicate of (E).

Plates of (A) and (B) should support the growth of heterokaryotic conidia only; plate (C) should support heterokaryotic conidia and those homokaryotic for component II (al-2, pan-2, cot); plate (D) should support the growth of heterokaryotic conidia and those homokaryotic for component I (hist-2 ad-3A ad-3B nic-2; ad-2; inos); plates (E) and (F) should provide an assay for survival of heterokaryotic conidia and homokaryotic conidia of both types.

Ordinarily, in low dose experiments, all plates are counted and the counts are used to estimate the survival of the heterokaryotic conidia and each type of homokaryotic conidia. The colony counts from the minimal plates are multiplied by an appropriate conversion factor to obtain an estimate of the heterokaryotic conidial concentration per ml of original suspension. The latter figure is divided by the number of conidia per ml of original suspension to estimate the proportion of heterokaryotic survivors. These plating data for the Biosatellite A ground control experiment are listed in Table 4.

VI. JUG DATA FOR BIOSATELLITE A GROUND CONTROL EXPERIMENT

Twelve-liter flasks of recovery medium were inoculated with conidia from each treatment. Usually eight flasks were used per treatment, but only four jugs were used for each of two unirradiated filters. Table 4 includes, along with the plating data, a synopsis of the jug data, with estimated heterokaryotic survivals, expressed both as a proportion of conidia plated and as a percentage of the survival in unirradiated control conidia. The estimated forward-mutation frequencies for each treatment are also included. In Figure 2 the logarithms of forward-mutation frequencies are plotted against the logarithms of radiation exposures for the nine irradiated samples used in the genetic analysis. The curve was determined by regression analysis. Dose-response data obtained with X-rays with an exposure rate of 10 R/min are also shown; these appear as a continuation of the ^{85}Sr gamma radiation data, as one would predict for an RBE of 1.0.

VII. SELECTION OF MUTANTS FOR FURTHER GENETIC ANALYSIS

The following criteria for selecting mutants from each sample for further genetic analysis are generally used: (1) the mutants should have been induced by total radiation exposures which cover the full range of exposures available and which would represent approximately evenly spaced segments of that range in a logarithmic plot; (2) the mutants should be truly representative of a hypothetical population and not a sample biased by the selection procedure; (3) the sample from each dose-point should contain 150-175 mutants, or as close to this as possible. For the Biosatellite A ground control experiment, mutants from treatment 2 (6854R) and treatment 4 (3600R) were not saved for analysis because their exposures were too similar to those from other samples. At the lower radiation exposures, the numbers of mutants per treatment were all well below 150, so the total samples were saved. The genetic analysis of the selected mutants is in progress.

VIII. CONCLUSIONS CONCERNING THE BIOSATELLITE A EXERCISE

On the basis of the results with the ground-control portion of the Biosatellite A experiment, it is possible to state that the flight preparations can be carried out in the alloted time, and that full data return can be expected with a nominal mission.

Solutions had not yet been found for noncritical problems in the following areas: (1) malfunction of thermistors, resulting in inaccurate estimates of the assembly temperatures during flight; and (2) difficulties in the dosimetry system, which are to be reviewed in a subsequent report. In addition to these, the time required for the characterization of induced ad-3 mutants is, at present, rather long. This is considered an unavoidable consequence of the type and amount of work required for a detailed analysis. These tests are expected to proceed more rapidly as a consequence of a recently completed electronic data processing program.

IX. DATA RECORDING AND ELECTRONIC DATA PROCESSING

The present section indicates the capabilities which have been developed for the accurate and complete collection of data on survival and mutation in each experiment and the conversion of these data into dose-effect curves. The data are first recorded onto sheets designed to insure the proper entry of all pertinent information. The data are then transferred to punch cards and used as a basis for computations which provide such secondary data as mean survivals, forward-mutation frequencies, and dose-effect curves. The data sheets used in the collection and processing of data in these experiments will be described below and representative samples will be presented on subsequent pages.

A) Data Sheet 80210: Experiment Information Sheet. — This sheet contains space to record the wild-type strain used, experiment number, and a brief description of the mutagenic treatment. In cases where the different conidial aliquots have treatments which differ quantitatively, e. g., hours of treatment with a chemical mutagen or total exposure to ionizing radiation, these quantities are listed with corresponding arbitrary treatment numbers listed next to them. The main function of this sheet is to define the treatment numbers which are used on all tubes and plates receiving these samples later; it also provides the units for the abscissa in the dose-response regression analysis. The date is required on this sheet because sometimes one type of treatment definition may be replaced by another. For instance, in the Biosatellite experiments, a module and filter number might be used to define the arbitrary treatment numbers at first. This could later be replaced with a tentative gamma radiation exposure in Roentgens and even later with a more precise estimate of the exposure when the dosimetry is completely analyzed. The sheet with the most recent date would be expected to be most accurate and useful.

B) Data Sheet 80211: Haemocytometer Count After Resuspending the Conidia From Millipore Filters. — This data sheet contains space for the wild-type strain used, the experiment number, the arbitrary treatment number for the conidial aliquot, the dilution used (if the original suspension should be too concentrated), an arbitrary designation for the volume of each square being counted (i. e., #13 for 4 X 10^{-6} ml or #04 for 2.5 X 10^{-7} ml, the number of squares combined to give a particular count, and the number of conidia in that number of squares. The data from such sheets can be used to estimate the conidial concentration for each treatment (suspension) listed.

C) Data Sheet 80220: Heterokaryon: Plate Counts. — This data sheet contains space for the wild-type strain used, the experiment number, the arbitrary designation for the technician performing the colony counts, the arbitrary treatment number, the designation for the replicate (if two or more aliquots of each kind of medium are used), the number of Petri plates used for each aliquot of medium, the factor by which the original suspension is diluted before an aliquot of the diluted suspension is added to medium, the number of milliliters of dilute suspension added to aliquots of each of four different types of media, and the number of colonies counted in each aliquot of medium after an appropriate incubation period.

The 80220 and 80211 sheets together provide data which can be used to estimate heterokaryotic and general survival as well as survival of each of the two components in the heterokaryon.

D) Data Sheet 80213: Jug Harvesting Data Worksheet. — This sheet contains space at the top for the wild-type strain used, the experiment number, the arbitrary treatment number (as above), the number of the jug, and the volume of suspension inoculated into the jug. During harvesting, the contents of each jug is subdivided into five aliquots of 1500 ml each and a sixth containing the remainder of the jug (typically 1300-1800 ml). From each of these six aliquots, a 10-ml aliquot is removed and colonies are counted to permit an estimate of total colonies in the jug. The data sheet provides space for the sample numbers (1 through 6), the number of milliliters in each aliquot, the number of milliliters in the smaller samples for counting background, the number of background colonies in each small aliquot, a number identifying the technician who screens the 1500-ml aliquot for purple colonies, the number of purple colonies found, the range of arbitrary isolate numbers assigned to the purple colonies when they are sub-cultured in tubes of medium, and the number of samples per jug (which is required so that the data processing machine will include all aliquots from the jug). The spaces for purple pigmentation and colony morphology are not being used at present; irregularities in pigmentation or morphology are noted at the bottom of the sheet as comments.

The 80213 and 80211 sheets provide data which can be used to estimate the proportion of conidia which are heterokaryotic and surviving as well as the incidence of purple colonies among survivors for each jug.

E) Computer Analysis of Jug Data. — The computer print-out presents the results of computations performed upon the above types of data. Usually the data for individual jugs are obtained first (pp. 20-22 below) and plotted or otherwise examined along with the data sheets to see whether any data for particular jugs should be discarded as atypical. For instance, if a jug showed unusually low survival and poor morphology, or if a jug showed a low mutation frequency and poor pigmentation, then one might consider omitting it from further computations on the assumption that the medium or aeration conditions were abnormal. The data from all jugs lacking such irregularities are then pooled from each treatment (pp. 23-32); the mean incidence of mutants among survivors and the heterokaryotic conidial survival, expressed both as a function of conidial number and as a function of the survival in the untreated controls (along with standard errors and 95% confidence limits for these parameters) is presented for each treatment. At the end of the print-out (pp. 33-35) regression lines are described for the log of heterokaryotic survival (as a function of untreated control incidence) plotted against exposure and for the log of mutant frequency plotted against the log of exposure. These data are obtained about 3 to 4 weeks after jug inoculation.

F) Characterization of ad-3 Mutants. — Additional data sheets have been developed for describing the isolation of the dikaryotic adenine-requiring strains from original purple colonies and for making a stock culture to be used in the subsequent genetic characterization. Others are available for recording the results of heterokaryon complementation tests and platings which are required in the classification of the mutants obtained. Procedures are being developed for providing print-outs which correlate these data and which automatically check for continuity in the data obtained from different tests with the same mutant. These additional sheets and techniques will be described in a subsequent report.

Table 1

SHIPPING CONTAINER TALLY 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

REQUISITION AND INVOICE/SHIPPING DOCUMENT

NAS 2-1900

SHEET NO. 1 / NO. OF SHEETS 1	5. REQUISITION DATE
6. REQUISITION NO.	
7. DATE MATERIEL REQUIRED	8. PRIORITY

1. FROM: Oak Ridge National Laboratory - Biology Div., Oak Ridge, Tenn.

2. TO: Transportation Officer, Patrick AFB, Florida
General Electric Co. ETR, Hangar "S"
Cape Kennedy, Florida Attn: J. R. Krepps M/F NAS 2-1900

3. SHIP TO-MARK FOR:

9. AUTHORITY OR PURPOSE: J. Gillespie/ Hemiup Agreement*

10. SIGNATURE: [signature]

11a. VOUCHER NUMBER AND DATE: CS66 - 19 - 0039-2

12. DATE SHIPPED: 12/13/66

b. VOUCHER NUMBER AND DATE: 12/12/66

13. MODE OF SHIPMENT: Hand carried

14. BILL OF LADING NUMBER:

15. AIR MOVEMENT DESIGNATOR OR PORT REFERENCE NUMBER:

4. ACCOUNTING AND FUNDING DATA: 80X0108 (64) /2510-R-2100

ITEM NO. a	FEDERAL STOCK NUMBER, DESCRIPTION, AND CODING OF MATERIEL, AND/OR SERVICES b	UNIT OF ISSUE c	QUANTITY Shipped	SUPPLY ACTION e	TYPE CONTAINER f	CONTAINER NOS. g	UNIT PRICE h	TOTAL COST i
1	47D168798G1, Neurospora Modules, S/N's 19,2,24,15,23,10	ea	6					
2	47D168798G1, Neurospora Modules, (201); XXI, A818, XXII, A816, A817, VI 38, XIII 31, XXIII, and XXIV.	ea	9					
	* DCASO, GE ltr DCRP- RV - QMA dtd 17 Oct 1966							
	Note: Transfer of accountability is to J. R. Krepps							
	Note: FTI 239952C Task A for loading and assembling Neurospora modules verification sheet attached.							

16. TRANSPORTATION VIA MATS OR MSTS CHARGEABLE TO

17. SPECIAL HANDLING

18. RECAPITULATION OF SHIPMENT	TOTAL CONTAINERS	TYPE CONTAINER	DESCRIPTION	TOTAL WEIGHT	TOTAL CUBE
ISSUED BY					
CHECKED BY					
PACKED BY					
	←		TOTAL	→	

19. RECEIPT	DATE	BY	
CONTAINERS RECEIVED EXCEPT AS NOTED	DATE	BY	SHEET TOTAL
QUANTITIES RECEIVED EXCEPT AS NOTED	DATE	BY	GRAND TOTAL
POSTED	DATE	BY	20. RECEIVER'S VOUCHER NO.

51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

DD FORM 1 MAR 59 1149 REPLACES EDITION OF 1 MAY 58 WHICH MAY BE USED

Table 2. Temperature Readings for Modules Used in Biosatellite A Flight and Ground Control Exercise

Module Designation	Housing Designation	Position in Flight Vehicle or Control Experiment	Temperature Record
23	29	A809-flight; aft; no radiation	94-100°F.*
24	27	A816-flight; fore; 500 R	105°F.*
2	5	A817-flight; fore; 2500 R	78-93°F.*
10	6	A818-flight; fore; 1000 R	68-70°F.
19	10	A819-flight; fore; 6000 R	68-70°F.
5	2	Control II; constant temperature	70-72°F.
A817	16	Control I (vehicle); 6000 R	68-72°F.
XXI	17	Control I (vehicle); 2500 R	68-72°F.
XIII	18	Control I (vehicle); 1000 R	68-72°F.
XXIII	19	Control I (vehicle); 500 R	68-72°F.
A818	20	Control I (vehicle); aft, no radiation	68-72°F.
31 (48)	XXIV	Control III; variable temperature	67-69°F.
39	XXII	Control III; variable temperature	66-67°F.
35	A816	Control II; constant temperature	
37	VI	Control II; constant temperature	70-72°F.

*Temperature readings considered spurious owing to thermistor malfunction.

Table 3. Estimated Exposures for the Biosatellite A Ground Control Experiment and Data Used to Obtain the Estimates

Module Designation and Test Position	Filter Position	Distance from Dosimeter to Radiation Source (Centimeters)	Thermoluminescence Reading for Individual Filters (Arbitrary Units)	Exposures from Calibration Curve (Roentgens)	Estimated Exposures from Regression Analysis
A817 (6000 R)	1*	6.12	1367	7850	7583
			1242	7200	
			1321	7600	
	2*	6.43	1230	7200	6854
			885	5600	
			1064	6500	
	6*	7.67	702.6	4600	4778
			716.0	4650	
			652.0	4350	
	9	8.60	459.4	3300	3781
			422.0	3050	
			466.4	3350	
	10*	8.91	512.0	3600	3517
			522.4	3650	
			511.0	3600	
XXI (2500 R)	1*	9.67	460.0	3300	2974
			461.7	3300	
			469.0	3350	
	2	9.98	307.8	2400	2788
			349.5	2650	
			398.6	2950	
	6*	11.22	362.6	2700	2194
			390.6	2900	
			268.6	2150	
	9*	12.15	230.6	1900	1864
			236.2	1920	
			245.0	2000	
	10	12.46	235.6	1900	1771
			202.0	1700	
			236.4	1900	
XIII (1000 R)	1*	15.10	148.6	1350	1195
			141.2	1300	
			151.0	1370	
	2	15.41	119.8	1150	1146
			150.4	1370	
			119.6	1150	
	6	16.65	80.1	830	979
			99.8	1000	
			95.5	960	
	9*	17.58	85.0	870	876
			84.8	870	
			88.5	910	
	10	17.89	92.0	930	845
			83.6	870	
			84.6	880	
XXIII (500 R)	1	20.94	49.6	540	612
			66.3	720	
			44.5	480	
	2	21.25	60.2	650	594
			55.2	600	
			48.1	520	
	6	22.49	52.8	570	529
			50.0	540	
			50.0	540	
	9	23.42	46.6	510	487
			39.5	435	
			34.2	385	
	10	23.73	37.1	410	474
			38.8	430	
			43.5	480	

*Conidia on these filters were used in the assay.

Table 4. Plating and Jug Data for the Biosatellite A Ground Control Experiment

Arbitrary Treatment Number	Module Designation	Filter Position	Distance from Radiation Source	Radiation Exposure	Plating Data for Survival of Heterokaryotic Conidia: Proportion of all Conidia	Plating Data for Survival of Heterokaryotic Conidia: Percentage of Controls (0.1495)	Data from Jug Experiment: Jug Numbers	Data from Jug Experiment: Survival of Heterokaryotic Conidia: Average Proportion of all Conidia	Data from Jug Experiment: Survival of Heterokaryotic Conidia: Percentage of Controls (0.1454)	Data from Jug Experiment: Forward-Mutation Frequencies
11	A817	1	6.12 cm	7583 R	0.1596	106.8	1-8	0.1035	71.2	97.9×10^{-6}
10	A817	2	6.43 cm	6854 R	0.1367	91.4	9-13, 15-16	0.1199	82.4	76.1×10^{-6}
9	A817	6	7.67 cm	4778 R	0.1438	96.2	17-24	0.1028	70.7	59.5×10^{-6}
8	A817	10	8.91 cm	3517 R	0.1209	80.9	25-32	0.0875	60.2	65.1×10^{-6}
7	XXI	1	9.67 cm	2974 R	0.1476	98.7	33-40	0.0801	55.1	56.4×10^{-6}
6	XXI	6	11.22 cm	2194 R	0.1264	84.5	41-48	0.0806	55.4	34.6×10^{-6}
5	XXI	9	12.15 cm	1864 R	0.1552	103.8	51-56	0.0981	67.5	25.7×10^{-6}
4	XIII	1	15.10 cm	1195 R	0.1266	84.7	57-64	0.0975	67.1	15.7×10^{-6}
3	XIII	9	17.58 cm	876 R	0.1163	77.8	65-72	0.1001	68.8	7.0×10^{-6}
2	A818	1	unirradiated		0.1495	(1.0000)	73-76	0.1454	(1.0000)	0.6×10^{-6}
1	A818	9	unirradiated				77-80			

(Data Sheet 80210 – Section IX A, this report)

EXPERIMENT INFORMATION SHEET

Card type					Wildtype			Exp. no.		
1	2	3	4	5	6	7	8	9	10	11
8	0	2	1	0						

COLS. 20-80 Treatment Description:

Treatment Number 12 – 14	Dose 15 – 19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

HEMACYTOMETER COUNT AFTER RESUSPENDING THE CONIDIA FROM MILLIPORE FILTERS

DECK NUMBER

6-8 Wild Type

9-11 Experiment

CARD NUMBER

80211

Treatment 12-14	Dilution 15-18	Counted 19-20	Basic Unit 21-22	Technician 23-24	No. Units 25-26	Count 27-30	No. Units 31-32	Count 33-36	No. Units 37-38	Count 39-42	No. Units 43-44	Count 45-48

(Data Sheet 80211 — Section IX B, this report)

(Data Sheet 80220 — Section IX C, this report)

HETEROKARYON
PLATE COUNTS

Wild Type 6-8: ☐☐☐ Experiment 9-11: ☐☐☐ Deck Number 1-3: 8 0 2 Card Number 4-5: 2 0

12-13	14-16	17-19	20-21	22-23	24-27	28-29	30-33	34-35	36-39	40-41	42-45	46-47	48-51	52-53	54-57
								Min. Sub. I		Comp. (I) Sub. II		Comp. (II) Sub. III		Comp. Sub. IV	
Technician	Exp. No.	Treatment	Replic.	No. of Plates	Dilution Factor (0000.)	Exp. of Dil. Factor	Factor for Percent Survival (0.000)	ml Plat. (0.0)	Col. Counted	ml Plat. (0.0)	Col. Counted	ml Plat. (0.0)	Col. Counted	ml Plat. (0.0)	Col. Counted

UCN-8417
(3 11-67)

JUG HARVESTING DATA WORKSHEET

1-5	Wild Type 6-8	Experiment 9-11	Treatment 12-14	Jug 15-17	Vol. Inoc. 18-20
8 0 2 1 3					

Sample No.	21-22	50-51	21-22	50-51	21-22	50-51
Sample vol. for mutants	23-26	52-55	23-26	52-55	23-26	52-55
Sample vol. background	27-28	56-57	27-28	56-57	27-28	56-57
Background count	29-32	58-61	29-32	58-61	29-32	58-61
Technician	33-34	62-63	33-34	62-63	33-34	62-63
Purple Colonies	35-38	64-67	35-38	64-67	35-38	64-67
First Isolate No.	39-42	68-71	39-42	68-71	39-42	68-71
Last Isolate No.	43-46	72-75	43-46	72-75	43-46	72-75
Purple pigmentation	47	76	47	76	47	76
Colony morphology	48-49	77-78	48-49	77-78	48-49	77-78
No. samples per jug		79-80		79-80		79-80

Comments:

(Data Sheet 80213 — Section IX D, this report)

UCN-7204
(3 12-65)

BIOSATELLITE A GROUND CONTROL

EXP.	TR.	DOSE	JUG	ISOLATES		PURPLES					
59	1	0.	77	0	0	0.	0.0	0.1276	4291667.	1.00	4291667.
59	1	0.	78	0	0	0.	0.0	0.1370	4291667.	1.00	4291667.
59	1	0.	79	0	0	0.	0.0	0.1274	4291667.	1.00	4291667.
59	1	0.	80	0	0	1.	0.1584863D-05	0.1470	4291667.	1.00	4291667.
59	2	0.	73	0	0	1.	0.1192531D-05	0.2001	4191667.	1.00	4191667.
59	2	0.	74	0	0	0.	0.0	0.1467	4191667.	1.00	4191667.
59	2	0.	75	0	0	0.	0.0	0.1385	4191667.	1.00	4191667.
59	2	0.	76	0	0	1.	0.1713735D-05	0.1392	4191667.	1.00	4191667.
59	3	876.	65	0	0	4.	0.8246544D-05	0.1126	4308333.	1.00	4308333.
59	3	876.	66	0	0	2.	0.5086179D-05	0.0913	4308333.	1.00	4308333.
59	3	876.	67	0	0	1.	0.2258016D-05	0.1028	4308333.	1.00	4308333.
55	3	876.	68	0	0	3.	0.6628077D-05	0.1051	4308333.	1.00	4308333.
59	3	876.	69	0	0	1.	0.2251204D-05	0.1031	4308333.	1.00	4308333.
59	3	876.	70	0	0	7.	0.1665269D-04	0.0976	4308333.	1.00	4308333.
59	3	876.	71	0	0	2.	0.4897639D-05	0.0948	4308333.	1.00	4308333.
59	3	876.	72	0	0	4.	0.9953309D-05	0.0933	4308333.	1.00	4308333.
59	4	1195.	57	0	0	10.	0.2384501D-04	0.0918	4566667.	1.00	4566667.
59	4	1195.	58	0	0	8.	0.1782002D-04	0.0983	4566667.	1.00	4566667.
59	4	1195.	59	0	0	10.	0.2293157D-04	0.0955	4566667.	1.00	4566667.
59	4	1195.	60	0	0	4.	0.1102369D-04	0.0795	4566667.	1.00	4566667.
59	4	1195.	61	0	0	7.	0.1390540D-04	0.1102	4566667.	1.00	4566667.
59	4	1195.	62	0	0	9.	0.2143712D-04	0.0919	4566667.	1.00	4566667.
59	4	1195.	63	0	0	5.	0.1006041D-04	0.1088	4566667.	1.00	4566667.
59	4	1195.	64	0	0	2.	0.4202453D-05	0.1042	4566667.	1.00	4566667.
59	5	1864.	51	0	0	9.	0.2588699D-04	0.0802	4333333.	1.00	4333333.

59	5	1864.	52	0	0	13.	0.3669276D-04	0.0818	4333333.	1.00	4333333.
59	5	1864.	53	0	0	13.	0.3443215D-04	0.0871	4333333.	1.00	4333333.
59	5	1864.	54	0	0	7.	0.1252600D-04	0.1290	4333333.	1.00	4333333.
59	5	1864.	55	0	0	11.	0.2530617D-04	0.1003	4333333.	1.00	4333333.
59	5	1864.	56	0	0	7.	0.1949114D-04	0.1105	4333333.	0.75	3250000.
59	6	2194.	41	0	0	12.	0.3568906D-04	0.0740	4541667.	1.00	4541667.
59	6	2194.	42	0	0	9.	0.2625469D-04	0.0755	4541667.	1.00	4541667.
59	6	2194.	43	0	0	16.	0.4997501D-04	0.0705	4541667.	1.00	4541667.
59	6	2194.	44	0	0	18.	0.4784466D-04	0.0828	4541667.	1.00	4541667.
59	6	2194.	45	0	0	11.	0.2935705D-04	0.0825	4541667.	1.00	4541667.
59	6	2194.	46	0	0	8.	0.2000865D-04	0.0880	4541667.	1.00	4541667.
59	6	2194.	47	0	0	16.	0.4245252D-04	0.0830	4541667.	1.00	4541667.
59	6	2194.	48	0	0	10.	0.2495996D-04	0.0882	4541667.	1.00	4541667.
59	7	2974.	33	0	0	16.	0.5352439D-04	0.0666	4491667.	1.00	4491667.
59	7	2974.	34	0	0	31.	0.9195402D-04	0.0751	4491667.	1.00	4491667.
59	7	2974.	35	0	0	21.	0.5594902D-04	0.0836	4491667.	1.00	4491667.
59	7	2974.	36	0	0	18.	0.4756007D-04	0.0843	4491667.	1.00	4491667.
59	7	2974.	37	0	0	24.	0.6922945D-04	0.0772	4491667.	1.00	4491667.
59	7	2974.	38	0	0	21.	0.5590062D-04	0.0836	4491667.	1.00	4491667.
59	7	2974.	39	0	0	11.	0.3184160D-04	0.0769	4491667.	1.00	4491667.
59	7	2974.	40	0	0	19.	0.4531389D-04	0.0934	4491667.	1.00	4491667.
59	8	3517.	25	0	0	27.	0.7074244D-04	0.0933	4091667.	1.00	4091667.
59	8	3517.	26	0	0	27.	0.6902899D-04	0.0956	4091667.	1.00	4091667.
59	8	3517.	28	0	0	22.	0.4850534D-04	0.1108	4091667.	1.00	4091667.
59	8	3517.	29	0	0	15.	0.5814620D-04	0.0630	4091667.	1.00	4091667.
59	8	3517.	30	0	0	25.	0.7169384D-04	0.0852	4091667.	1.00	4091667.
59	8	3517.	31	0	0	21.	0.5946875D-04	0.0863	4091667.	1.00	4091667.

59	8	3517.	32	0	0	25.	0.7812093D-04	0.0782	4091667.	1.00	4091667.
59	9	4778.	27	0	0	19.	0.4265330D-04	0.1001	4450000.	1.00	4450000.
59	9	4778.	17	0	0	24.	0.4622615D-04	0.1167	4450000.	1.00	4450000.
59	9	4778.	18	0	0	36.	0.7352441D-04	0.1100	4450000.	1.00	4450000.
59	9	4778.	19	0	0	28.	0.5676865D-04	0.1108	4450000.	1.00	4450000.
59	9	4778.	20	0	0	30.	0.6106870D-04	0.1104	4450000.	1.00	4450000.
59	9	4778.	21	0	0	28.	0.7455732D-04	0.0844	4450000.	1.00	4450000.
59	9	4778.	22	0	0	22.	0.5425384D-04	0.0911	4450000.	1.00	4450000.
59	9	4778.	23	0	0	32.	0.7025941D-04	0.1023	4450000.	1.00	4450000.
59	9	4778.	24	0	0	25.	0.5651420D-04	0.0994	4450000.	1.00	4450000.
59	10	6854.	9	0	0	32.	0.6895035D-04	0.1175	3950000.	1.00	3950000.
59	10	6854.	10	0	0	29.	0.6875410D-04	0.1068	3950000.	1.00	3950000.
59	10	6854.	11	0	0	36.	0.7716904D-04	0.1181	3950000.	1.00	3950000.
59	10	6854.	12	0	0	43.	0.8954058D-04	0.1216	3950000.	1.00	3950000.
59	10	6854.	13	0	0	41.	0.8205676D-04	0.1265	3950000.	1.00	3950000.
59	10	6854.	15	0	0	37.	0.7418856D-04	0.1263	3950000.	1.00	3950000.
59	10	6854.	16	0	0	35.	0.7228020D-04	0.1226	3950000.	1.00	3950000.
59	11	7583.	1	0	0	58.	0.1169099D-03	0.1054	4708333.	1.00	4708333.
59	11	7583.	2	0	0	51.	0.1041909D-03	0.1040	4708333.	1.00	4708333.
59	11	7583.	3	0	0	38.	0.8372503D-04	0.0964	4708333.	1.00	4708333.
59	11	7583.	4	0	0	53.	0.1203105D-03	0.0936	4708333.	1.00	4708333.
59	11	7583.	5	0	0	43.	0.9035274D-04	0.1011	4708333.	1.00	4708333.
59	11	7583.	6	0	0	38.	0.7960032D-04	0.1014	4708333.	1.00	4708333.
59	11	7583.	7	0	0	55.	0.1024845D-03	0.1140	4708333.	1.00	4708333.
59	11	7583.	8	0	0	45.	0.8528865D-04	0.1121	4708333.	1.00	4708333.

BIOSATELLITE A GROUND CONTROL

EXPERIMENT 59 TREATMENT 1

NUMBER OF JUGS		8.	
MEAN JUG VOLUME		9237.50	
MEAN SAMPLE VOLUME		60.00	
DOSE			0.0
MEAN CONIDIA PER JUG			0.42416667D 07
VOLUME INOCULATED		1.00	
FIRST ISOLATE		0	
LAST ISOLATE		0	
BACKGROUND MEAN		4002.87	
	CSS		0.26094909D 07
	VAR. MEAN		0.46598051D 05
PURPLE MUTANT MEAN		0.38	
	CSS		0.18750000D 01
	VAR. MEAN		0.33482143D-01
MUTANT/SURVIVOR			0.56139119D-06
	VARIANCE		0.77670170D-13
	S.E.		0.27869356D-06
	CI 0.0		0.11633693D-05
	C.V.		0.49643380D 02
SURVIVAL FRACTION			0.14543214D 00
	VARIANCE		0.67692058D-04
	S.E.		0.82275160D-02
	CI 0.12766070D 00		0.16320357D 00
	C.V.		0.56572888D 01
SURVIVAL RATIO		1.00000000	
	VARIANCE		0.0
	S.E.		0.0
	CI 0.10000000D 01		0.10000000D 01
	C.V.		0.0

BIOSATELLITE A GROUND CONTROL

EXPERIMENT 59 TREATMENT 3		
NUMBER OF JUGS	8.	
MEAN JUG VOLUME	9170.00	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.87600000D 03
MEAN CONIDIA PER JUG		0.43083333D 07
VOLUME INOCULATED	1.00	
FIRST ISOLATE	0	
LAST ISOLATE	0	
BACKGROUND MEAN	2820.62	
CSS		0.28507587D 06
VAR. MEAN		0.50906406D 04
PURPLE MUTANT MEAN	3.00	
CSS		0.28000000D 02
VAR. MEAN		0.50000000D 00
MUTANT/SURVIVOR		0.69967073D-05
VARIANCE		0.27983693D-11
S.E.		0.16728318D-05
CI	0.33833905D-05	0.10610024D-04
C.V.		0.23908843D 02
SURVIVAL FRACTION		0.10005483D 00
VARIANCE		0.63547239D-05
S.E.		0.25208576D-02
CI	0.94609776D-01	0.10549988D 00
C.V.		0.25194762D 01
SURVIVAL RATIO	0.68798294	
VARIANCE		0.18153118D-02
S.E.		0.42606473D-01
CI	0.60055444D 00	0.77541143D 00
C.V.		0.61929549D 01

BIOSATELLITE A GROUND CONTROL		
EXPERIMENT 59 TREATMENT 4		
NUMBER OF JUGS	8.	
MEAN JUG VOLUME	9184.37	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.11950000D 04
MEAN CONIDIA PER JUG		0.45666667D 07
VOLUME INOCULATED	1.00	
FIRST ISOLATE	0	
LAST ISOLATE	0	
BACKGROUND MEAN	2910.75	
CSS		0.67991550D 06
VAR. MEAN		0.12141348D 05
PURPLE MUTANT MEAN	6.87	
CSS		0.60875000D 02
VAR. MEAN		0.10870536D 01
MUTANT/SURVIVOR		0.15653209D-04
VARIANCE		0.61627737D-11
S.E.		0.24824931D-05
CI	0.10291023D-04	0.21015394D-04
C.V.		0.15859324D 02
SURVIVAL FRACTION		0.97537979D-01
VARIANCE		0.13016688D-04
S.E.		0.36078647D-02
CI	0.89744991D-01	0.10533097D 00
C.V.		0.36989332D 01
SURVIVAL RATIO	0.67067693	
VARIANCE		0.20550377D-02
S.E.		0.45332525D-01
CI	0.57765458D 00	0.76369928D 00
C.V.		0.67592194D 01

BIOSATELLITE A GROUND CONTROL

EXPERIMENT 59 TREATMENT 5

NUMBER OF JUGS	6.	
MEAN JUG VOLUME	9158.33	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.18640000D 04
MEAN CONIDIA PER JUG		0.41527778D 07
VOLUME INOCULATED	0.96	
FIRST ISOLATE	0	
LAST ISOLATE	0	
BACKGROUND MEAN	2659.00	
CSS		0.15508660D 07
VAR. MEAN		0.51695533D 05
PURPLE MUTANT MEAN	10.00	
CSS		0.38000000D 02
VAR. MEAN		0.12666667D 01
MUTANT/SURVIVOR		0.25722534D-04
VARIANCE		0.13646076D-10
S.E.		0.36940592D-05
CI	0.17366571D-04	0.34078497D-04
C.V.		0.14361179D 02
SURVIVAL FRACTION		0.98149103D-01
VARIANCE		0.60597500D-04
S.E.		0.77844374D-02
CI	0.80540703D-01	0.11575750D 00
C.V.		0.79312364D 01
SURVIVAL RATIO	0.67487905	
VARIANCE		0.43227638D-02
S.E.		0.65747678D-01
CI	0.53884707D 00	0.81091103D 00
C.V.		0.97421424D 01

BIOSATELLITE A GROUND CONTROL		
EXPERIMENT 59 TREATMENT 6		
NUMBER OF JUGS	8.	
MEAN JUG VOLUME	9163.12	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.21940000D 04
MEAN CONIDIA PER JUG		0.45416667D 07
VOLUME INOCULATED	1.00	
FIRST ISOLATE	0	
LAST ISOLATE	0	
BACKGROUND MEAN	2396.62	
CSS		0.28148587D 06
VAR. MEAN		0.50265335D 04
PURPLE MUTANT MEAN	12.50	
CSS		0.96000000D 02
VAR. MEAN		0.17142857D 01
MUTANT/SURVIVOR		0.34567701D-04
VARIANCE		0.15671828D-10
S.E.		0.39587649D-05
CI	0.26016769D-04	0.43118634D-04
C.V.		0.11452207D 02
SURVIVAL FRACTION		0.80572521D-01
VARIANCE		0.53402346D-05
S.E.		0.23108947D-02
CI	0.75580988D-01	0.85564053D-01
C.V.		0.28680928D 01
SURVIVAL RATIO	0.55402143	
VARIANCE		0.12348460D-02
S.E.		0.35140377D-01
CI	0.48191337D 00	0.62612949D 00
C.V.		0.63427829D 01

BIOSATELLITE A GROUND CONTROL

EXPERIMENT 59 TREATMENT 7

NUMBER OF JUGS	8.	
MEAN JUG VOLUME	9195.00	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.29740000D 04
MEAN CONIDIA PER JUG		0.44916667D 07
VOLUME INCCULATED	1.00	
FIRST ISOLATE	0	
LAST ISOLATE	0	
BACKGROUND MEAN	2347.37	
CSS		0.40744187D 06
VAR. MEAN		0.72757478D 04
PURPLE MUTANT MEAN	20.12	
CSS		0.24087500D 03
VAR. MEAN		0.43013393D 01
MUTANT/SURVIVOR		0.56409134D-04
VARIANCE		0.40027961D-10
S.E.		0.63267644D-05
CI	0.42743322D-04	0.70074945D-04
C.V.		0.11215851D 02
SURVIVAL FRACTION		0.80063878D-01
VARIANCE		0.79472836D-05
S.E.		0.28190927D-02
CI	0.73974637D-01	0.86153118D-01
C.V.		0.35210544D 01
SURVIVAL RATIO	0.55052397	
VARIANCE		0.13457439D-02
S.E.		0.36684383D-01
CI	0.47524761D 00	0.62580034D 00
C.V.		0.66635396D 01

BIOSATELLITE A GROUND CONTROL

EXPERIMENT 59 TREATMENT 8

NUMBER OF JUGS	7.	
MEAN JUG VOLUME	9207.14	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.35170000D 04
MEAN CONIDIA PER JUG		0.40916667D 07
VOLUME INOCULATED	1.00	
FIRST ISOLATE	0	
LAST ISOLATE	0	
BACKGROUND MEAN	2331.86	
CSS		0.90605886D 06
VAR. MEAN		0.21572830D 05
PURPLE MUTANT MEAN	23.14	
CSS		0.10885714D 03
VAR. MEAN		0.25918367D 01
MUTANT/SURVIVOR		0.65100926D-04
VARIANCE		0.14660632D-10
S.E.		0.38289181D-05
CI	0.56673476D-04	0.73528377D-04
C.V.		0.58815110D 01
SURVIVAL FRACTION		0.87501309D-01
VARIANCE		0.31783327D-04
S.E.		0.56376681D-02
CI	0.75092799D-01	0.99909819D-01
C.V.		0.64429528D 01
SURVIVAL RATIO	0.60166419	
VARIANCE		0.26612998D-02
S.E.		0.51587787D-01
CI	0.49539332D 00	0.70793507D 00
C.V.		0.85741826D 01

BIOSATELLITE A GROUND CONTROL

EXPERIMENT 59 TREATMENT 9

NUMBER OF JUGS	9.	
MEAN JUG VOLUME	9200.00	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.47780000D 04
MEAN CONIDIA PER JUG		0.44500000D 07
VOLUME INOCULATED	1.00	
FIRST ISOLATE	0	
LAST ISOLATE	0	
BACKGROUND MEAN	2983.11	
CSS		0.67953689D 06
VAR. MEAN		0.94380123D 04
PURPLE MUTANT MEAN	27.11	
CSS		0.21888889D 03
VAR. MEAN		0.30401235D 01
MUTANT/SURVIVOR		0.59536219D-04
VARIANCE		0.14521176D-10
S.E.		0.38106655D-05
CI	0.51415692D-04	0.67656747D-04
C.V.		0.64005836D 01
SURVIVAL FRACTION		0.10281211D 00
VARIANCE		0.11959429D-04
S.E.		0.34582405D-02
CI	0.95442600D-01	0.11018162D 00
C.V.		0.33636510D 01
SURVIVAL RATIO	0.70694217	
VARIANCE		0.21649458D-02
S.E.		0.46528980D-01
CI	0.61179039D 00	0.80209395D 00
C.V.		0.65817237D 01

BIOSATELLITE A GROUND CONTROL		
EXPERIMENT 59 TREATMENT 10		
NUMBER OF JUGS	7.	
MEAN JUG VOLUME	9212.14	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.68540000D 04
MEAN CONIDIA PER JUG		0.39500000D 07
VOLUME INOCULATED	1.00	
FIRST ISOLATE	0	
LAST ISOLATE	0	
BACKGROUND MEAN	3084.00	
CSS		0.15328800D 06
VAR. MEAN		0.36497143D 04
PURPLE MUTANT MEAN	36.14	
CSS		0.14085714D 03
VAR. MEAN		0.33537415D 01
MUTANT/SURVIVOR		0.76134228D-04
VARIANCE		0.81093110D-11
S.E.		0.28476852D-05
CI	0.69866471D-04	0.82401984D-04
C.V.		0.37403482D 01
SURVIVAL FRACTION		0.11990027D 00
VARIANCE		0.65490629D-05
S.E.		0.25591135D-02
CI	0.11426766D 00	0.12553288D 00
C.V.		0.21343684D 01
SURVIVAL RATIO	0.82444140	
VARIANCE		0.24850280D-02
S.E.		0.49850054D-01
CI	0.72175025D 00	0.92713254D 00
C.V.		0.60465249D 01

BIOSATELLITE A GROUND CONTROL

EXPERIMENT 59 TREATMENT 11

NUMBER OF JUGS	8.	
MEAN JUG VOLUME	9244.37	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.75830000D 04
MEAN CONIDIA PER JUG		0.47083333D 07
VOLUME INOCULATED	1.00	
FIRST ISOLATE	0	
LAST ISOLATE	0	
BACKGROUND MEAN	3162.12	
CSS		0.32259887D 06
VAR. MEAN		0.57606942D 04
PURPLE MUTANT MEAN	47.62	
CSS		0.41587500D 03
VAR. MEAN		0.74263393D 01
MUTANT/SURVIVOR		0.97857823D-04
VARIANCE		0.29928637D-10
S.E.		0.54707061D-05
CI	0.86041097D-04	0.10967455D-03
C.V.		0.55904638D 01
SURVIVAL FRACTION		0.10347537D 00
VARIANCE		0.61852560D-05
S.E.		0.24870173D-02
CI	0.98103407D-01	0.10884732D 00
C.V.		0.24034873D 01
SURVIVAL RATIO	0.71150275	
VARIANCE		0.19126456D-02
S.E.		0.43733805D-01
CI	0.62176097D 00	0.80124453D 00
C.V.		0.61466812D 01

BIOSATELLITE A GROUND CONTROL

EXPERIMENT 59

WEIGHTED REGRESSION ANALYSIS LOG SURVIVAL RATIO ON DOSE

NUMBER OF X= 9. NUMBER OF JUGS= 69.

X TOTAL= 0.24535900D 06 X MEAN= 0.35559275D 04

Y TOTAL= -0.28798502D 02 Y MEAN= -0.41736959D 00

XSS= 0.12285816D 10 XCSS= 0.35610276D 09 REC = 0.81394676D-09

XYSS= -0.92735984D 05 XYCSS= 0.96694025D 04

YSS= 0.13040520D 02 YCSS= 0.10209008D 01

REDUCTION SS= 6.99991178

RESIDUAL SS= 6.04060811

RESIDUAL MEAN SQUARE= 0.86294402

F= 8.11166385 WITH 1 AND 8 DEGREES OF FREEDOM

STANDARD ERROR OF SLOPE= 0.26502647D-04

CONSTANT = 0.10000000D 01 SLOPE= -0.75482154D-04PLUS OR MINUS 0.56477135D-04 95 PER CENT CONFIDENCE INTERVAL

OBSERVED		EXPECTED
DOSE	S	S
0.876000D 03	0.687983D 00	0.936016D 00
0.119500D 04	0.670677D 00	0.913747D 00
0.186400D 04	0.674879D 00	0.868751D 00
0.219400D 04	0.554021D 00	0.847378D 00
0.297400D 04	0.550524D 00	0.798928D 00
0.351700D 04	0.601664D 00	0.766845D 00
0.477800D 04	0.706942D 00	0.697220D 00
0.685400D 04	0.824441D 00	0.596095D 00
0.758300D 04	0.711503D 00	0.564180D 00

BIOSATELLITE A GROUND CONTROL

EXPERIMENT 59

MINIMUM CHI SQUARE ESTIMATE FOR Y=1.-(1.-E**KD)**N

K= -0.69243621D-03 N= 1.01

OBSERVED		EXPECTED
DOSE	S	S
0.876000D 03	0.687983D 00	0.548785D 00
0.119500D 04	0.670677D 00	0.440383D 00
0.186400D 04	0.674879D 00	0.277406D 00
0.219400D 04	0.554021D 00	0.220813D 00
0.297400D 04	0.550524D 00	0.128732D 00
0.351700D 04	0.601664D 00	0.884074D-01
0.477800D 04	0.706942D 00	0.369313D-01
0.685400D 04	0.824441D 00	0.877320D-02
0.758300D 04	0.711503D 00	0.529589D-02

BIOSATELLITE A GROUND CONTROL

EXPERIMENT 59

WEIGHTED REGRESSION ANALYSIS LOG MUTANTS ON LOG DOSE

NUMBER OF X= 9. NUMBER OF JUGS= 69.

X TOTAL= 0.54830318D 03 X MEAN= 0.79464229D 01

Y TOTAL= -0.70260629D 03 Y MEAN= -0.10182700D 02

XSS= 0.43916285D 04 XCSS= 0.34579560D 02 REC = 0.28918818D-01

XYSS= -0.55451914D 04 XYCSS= 0.38015342D 02

YSS= 0.72002427D 04 YCSS= 0.45813729D 02

REDUCTION SS= 41.79249935

RESIDUAL SS= 4.02122916

RESIDUAL MEAN SQUARE= 0.57446131

F= 72.75076447 WITH 1 AND 7 DEGREES OF FREEDOM

STANDARD ERROR OF SLOPE= 0.12889040D 00

CONSTANT = 0.60776024D-08 SLOPE= 0.10993588D 01PLUS OR MINUS 0.27840327D 00 95 PER CENT CONFIDENCE INTERVAL

OBSERVED		EXPECTED
DOSE	MR	MR
0.876000D 03	0.699671D-05	0.104375D-04
0.119500D 04	0.156532D-04	0.146845D-04
0.186400D 04	0.257225D-04	0.239398D-04
0.219400D 04	0.345677D-04	0.286381D-04
0.297400D 04	0.564091D-04	0.400105D-04
0.351700D 04	0.651009D-04	0.481108D-04
0.477800D 04	0.595362D-04	0.673811D-04
0.685400D 04	0.761342D-04	0.100186D-03
0.758300D 04	0.978578D-04	0.111960D-03

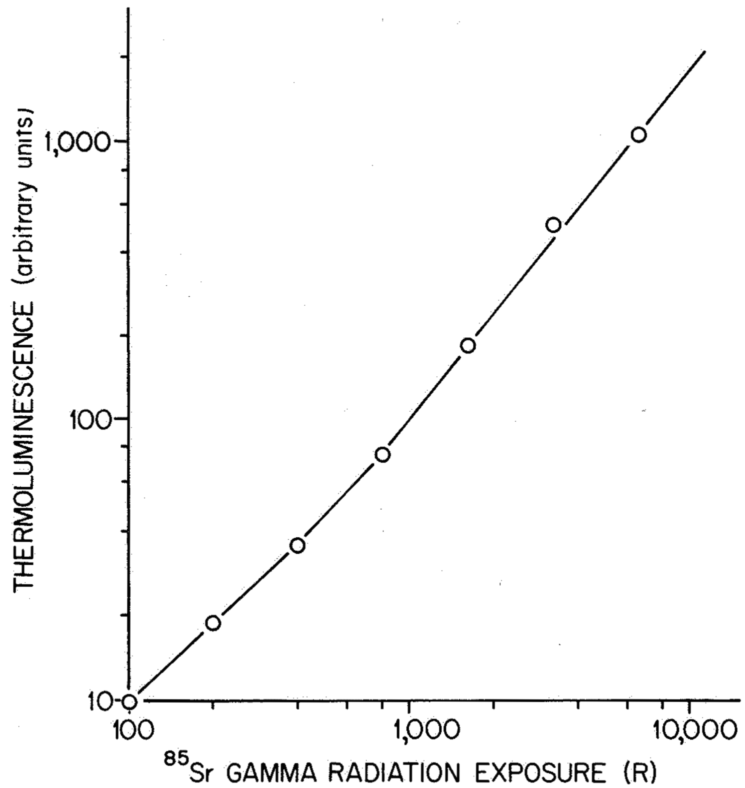

Figure 1. Calibration curve for lithium fluoride teflon disk dosimeters (lot No. 164144) used in 301 and 302 gantry exercises.

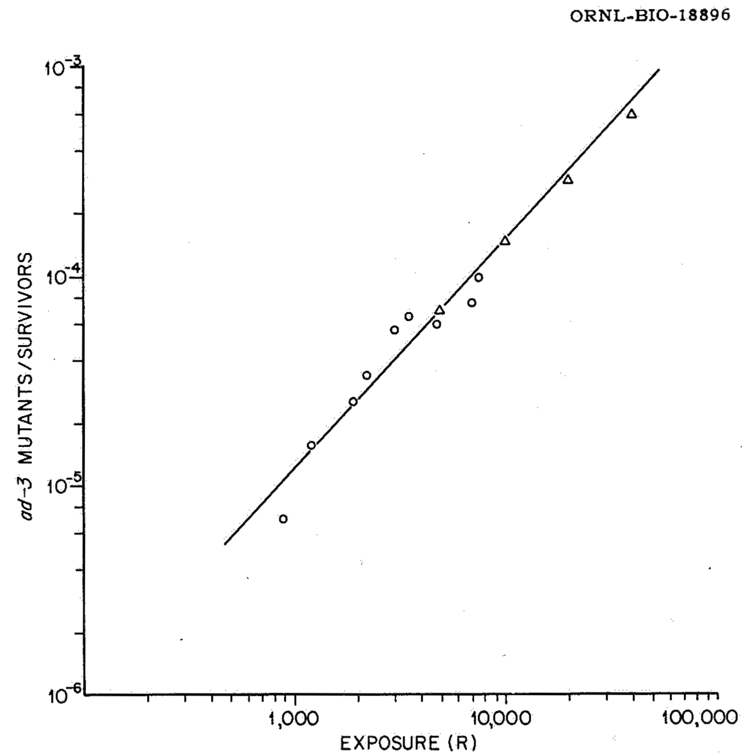

Figure 2. Forward-mutation data for the Biosatellite A ground control experiment. (O = forward-mutation frequency plotted against ^{85}Sr gamma radiation exposure in the Biosatellite ground control experiment; = forward-mutation frequency plotted against 250 kvp X-ray exposure at about 10 R/min in a previous laboratory experiment.)

INTERNAL DISTRIBUTION

1. M. A Bender
2. S. F. Carson
3-100. F. J. de Serres
101. W. H. Jordan
102. R. F. Kimball
103. C. E. Larson
104-113. J. L. Liverman
114. A. J. Miller
115. K. Z. Morgan
116. R. A. McNees
117. H. G. MacPherson
118-119. R. B. Parker
120. Diana B. Smith
121-130. Roger H. Smith
131-155. R. C. von Borstel
156. B. B. Webber
157. Anna R. Whiting
158. A. M. Weinberg
159-171. Biology Division Editorial Office
172. Biology Library
173-174. Central Research Library
175. ORNL — Y-12 Technical Library, Document Reference Section
176-180. Laboratory Records Department
181. Laboratory Records, ORNL RC
182. ORNL Patent Office

EXTERNAL DISTRIBUTION

183. Dr. R. L. Amy, Department of Biology, Southwestern University, Memphis, Tennessee
184. Mr. M. B. Baird, Department of Biology, University of Delaware, Newark, Delaware
185-190. Dr. N. Barr, Division of Research, U. S. Atomic Energy Commission, Washington, D.C.
191. Dr. A. M. Clark, Department of Biology, University of Delaware, Newark, Delaware
192. Dr. John R. Totter, Director, Division of Biology and Medicine, U. S. Atomic Energy Commission, Washington, D.C.
193. Dr. C. W. Edington, Chief, Biology Branch, Division of Biology and Medicine, U. S. Atomic Energy Commission, Washington, D.C.
194. Dr. D. S. Grosch, Department of Genetics, North Carolina State University, Raleigh, North Carolina
195. Dr. John E. Hewitt, Ames Research Center, Moffett Field, California
196. Capt. Walter Jones, Director, Biotechnology and Human Research, Office of Advanced Research and Technology, NASA, Washington, D.C.
197. Dr. W. Keller, Space Vehicle Research and Technology, Office of Advanced Research and Technology, NASA, Washington, D.C.
198. Dr. K. Kojima, Department of Zoology, University of Texas, Austin, Texas
199. Dr. Sohei Kondo, Faculty of Medicine, Osaka University, Osaka, Japan
200. Dr. L. E. LaChance, Metabolism and Radiation Research Laboratory, USDA, State University Station, Fargo, North Dakota

201-224. Miss Winnie M. Morgan, Technical Reports Office, Grants and Research Contracts, Office of Space Sciences, NASA, Washington, D.C.
225. Miss Mary Lou Pardue, Department of Biology, Yale University, New Haven, Connecticut
226-251. Mr. T. Smull, Director, Grants and Research Contracts, Office of Space Sciences, NASA, Washington, D.C.
252. Dr. John W. Tremor, Ames Research Center, Moffett Field, California
253. Mr. L. R. Valcovic, Department of Genetics, North Carolina State University, Raleigh, North Carolina
254-255. Biotechnology and Human Research, Office of Advanced Research and Technology, NASA, Washington, D.C.
256-258. Director, Bio-Science Programs, Office of Space Sciences, NASA, Washington, D.C.
259-274. Division of Technical Information Extension
275. Laboratory and University Division, AEC, ORO